CRM

CULTURAL RESOURCE MANAGEMENT
Information for Parks, Federal Agencies, Indian Tribes, States, Local Governments, and the Private Sector

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The Automobile Landscape

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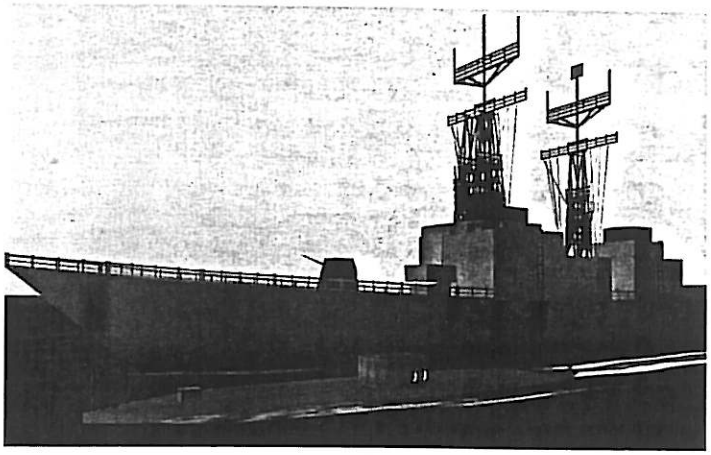
Cultural Resources

New Technology

James C. Massey and Fred M. Robinette

Adapting Digital Technology Used in Ship Design to Cultural Resources

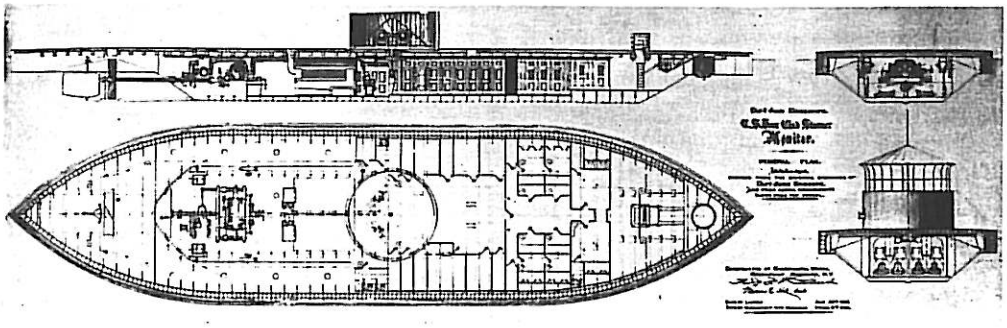


Digital technology used for new ship design is used to recreate USS Monitor.

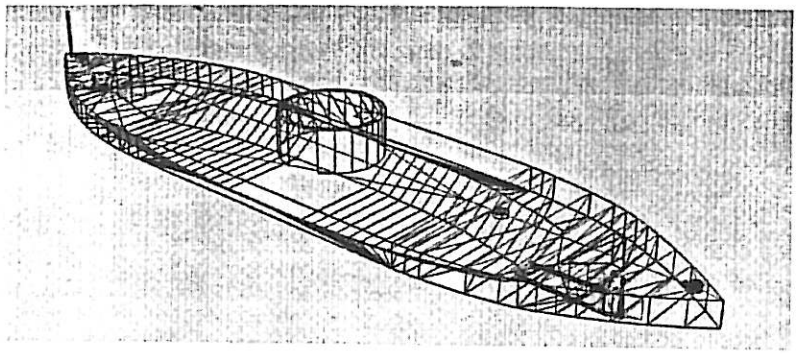
Advanced computer modeling and simulation programs have been successfully used in many industries to realistically evaluate and enhance performance of a design prior to construction. Now we can look forward toward 3-D digital technology for complex subject documentation and to record what was not previously recordable graphically to HABS/HAER standards. This has been accomplished through the transfer of existing defense design technology to CRM purposes through 3-D CAD-based analysis using precise sequential engineering data, rather than creating the visual depictions traditionally used. The virtual environments created by such advanced technology permit the documentation of dynamic behavior of ships and structures according to the laws of physics supported by engineering and structural data. Unlike present efforts using static isometric cutaway drawings and sections, computer dynamic visualization and simulation can add a major new dimension to documentation—the documentation of motion, which National Preservation Institute is now exploring for CRM uses.

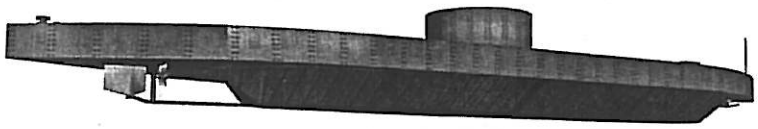
One of the most intriguing and complex uses of these tools has been for the design of U. S. Navy ships, in which the design process has moved from the drawing board to the computer. This makes use of such relevant digital technologies as computer-aided design, engineering, and rendering; high-performance visualization; simulation-based design; and virtual prototyping. The development of a ship's hull form is now assisted by software programs producing the ship's lines in three dimensions, based on its mission profile, which defines the size, speed, and operation characteristics. After the hull lines are developed, the internal and topside plans are developed. These plans, or layouts, use the 3-D model of the hull lines, thus determining the location and configuration of the various spaces and functions in the ship design. Simulations allow virtual prototyping of system operations, such as the flow of personnel, materials, and ordnance. Complex dynamic-motion operations, such as roll-on/roll-off capability of various vehicles, deployment of equipment such as ramps, launching of small boats and cargo container handling by shipboard cranes, anchor handling; and other mechanically-aided operations are conducted using this simulation technology. Before the use of digital simulation technology, design decisions based on dynamic motion could not be made in lieu of the actual construction of the real hardware or a scale-model mockup. In a computer-generated virtual environment, often referred to as virtual reality, "virtual" ships can be placed into a "virtual" sea and maneuvers and operations conducted in various sea states and environmental conditions selected at will, with behavior and interaction of the simulated components modeled strictly in accordance with the laws of physics and the principles of hydrodynamics.

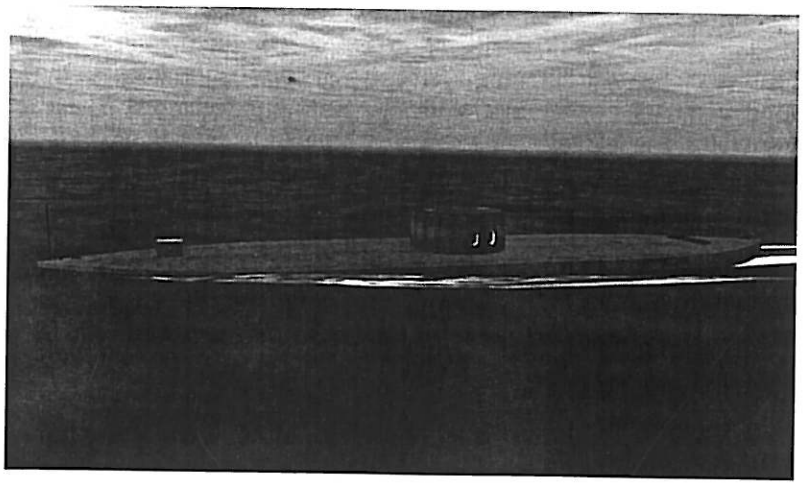
Below, general plan of iron clad steamer USS Monitor. Deduced from the original drawings of Capt. John Ericsson and measurements of actual vessel. Courtesy NOAA, Monitor National Marine Sanctuary.



Advanced Marine Enterprises (AME) has pioneered the use of computer modeling and simulation to build and operate ships and ship systems in virtual environments. Just as ships not yet built can be designed and







Top: computer-generated wire-frame perspective. Middle: shell superimposed. Below: USS Monitor *in a "virtual" ocean.*

Images generated for National Preservation Institute grant.

accurately modeled, and their operations realistically simulated, so can historic ships and other historic properties long since gone be reconstructed, analyzed, and studied in a virtual ocean or other environment. For the National Preservation Institute, AME is currently participating in a research grant from the National Center for Preservation Technology and Training (NCPTT) to demonstrate the application of advanced modeling, simulation, and visualization technology for enhanced cultural resources documentation, with emphasis on maritime and historic properties with dynamic motion. The subject selected for this demonstration is the famed Civil War ironclad USS *Monitor* of 1862. This study has focused on the dynamic motion of the complex turret rotation system and its associated machinery. Also addressed is the dynamic motion of the ship in a seaway.

In a separate study for the National Maritime Initiative of the NPS History Program, ship stability software is being used to study the sinking behavior of the USS *Tecumseh* in Mobile Bay in 1864. This software is in use on U.S. Navy and Coast Guard ships for stability and damage control purposes. This, also, is an example of the adaptation of defense technology to CRM purposes.

The new digital documentation can, for example, show aspects of dynamic behavior in real time or slow motion or at selected rates of movement, revolution, and environmental or other external forces. It can also support analyses of the behavior of structures such as cranes, tall buildings, wind tunnels, machinery, and material processes, for example, using accurate physical data rather than generalized pictorial graphics.

Can this new approach to documentation meet the Secretary of the Interior's standards for documentation? Would new sections of the standards be appropriate to guide the characteristics of such documentation, i.e., standards for a documentation level involving movement accompanied by physical data? How would records fit into the Library of Congress tradition of easy public access and reproducibility? Would CD-ROM discs be the answer? These could document the characteristics of motion at selected points or aspects of motion, for example, every 15 degrees of a 360-degree revolution of a turning object, including structural and engineering data for each selected point. Selected steps in a material-handling or industrial process could also be detailed by selected phases and time, as well as movement.

Will these new levels of documentation be useful to the CRM community to better understand the effect of motion of objects? Or, is the static summary of an isometric cutaway or section sufficient? Is CD-ROM the best media for presenting such documentation to the public, or should some other digital format be sought? Experiences that the CRM community has had in these new directions should be shared. NPI believes that the new digital technology will provide significant enhancement to cultural resources documentation and education with continuing advances in computer technology.

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